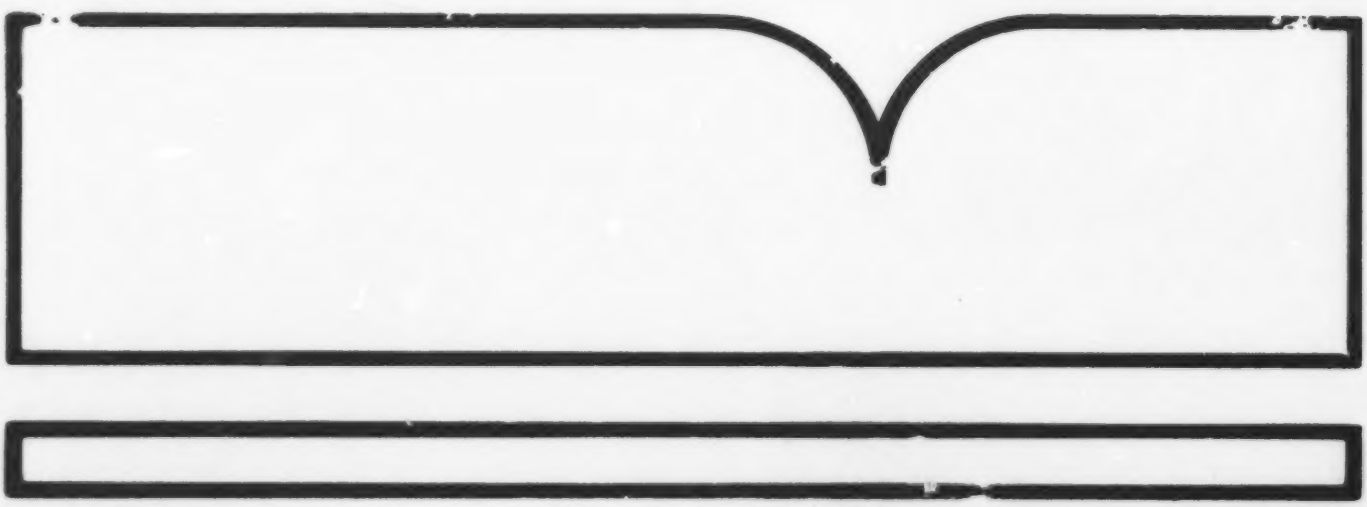
PB92-185859

Pesticide Fact Sheet Number 234: Ethylene Oxide (EtO)

(U.S.) Environmental Protection Agency, Washington, DC

31 May 90



U.S. Department of Commerce
National Technical Information Service
NTIS

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. PB92-185859

4. Title and Subtitle

EPA Pesticide Fact Sheets - Ethylene Oxide (Eto) No. 234

5. Report Date

6.

7. Author(s)

EPA, Office of Pesticide Programs, Special Review & Rereg. Div.

8. Performing Organization Rept. No.

540/FS-92-195

9. Performing Organization Name and Address

U.S. Environmental Protection Agency
Office of Pesticide Programs
Special Review & Reregistration Division (H7508C)
401 M Street, S.W.
Washington, D.C. 20460

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.

(C)

(G)

12. Sponsoring Organization Name and Address

same as #9

13. Type of Report & Period Covered

14.

15. Supplementary Notes

ethylene oxide

16. Abstract (Limit: 200 words)

This document contains up-to-date chemical information, including a summary of the Agency's regulatory position and rationale, on a specific pesticide or group of pesticides. A Fact Sheet is issued after one of the following actions has occurred.

1. Issuance or reinssuance of a registration standard,
2. Issuance of each special review document,
3. Registration of a significantly changed use pattern,
4. Registration of a new chemical, or
5. An immediate need for information to resolve controversial issues relating to a specific chemical or use pattern.

17. Document Analysis a. Descriptors

Pesticides, regulations, Chemical Information Fact Sheet, Use Patterns, science findings.

b. Identifiers/Open-Ended Terms

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
SPRINGFIELD, VA. 22161

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Publicly Available	unclassified	8
	20. Security Class (This Page) unclassified	22. Price

United States Environmental Protection Agency
Office of Pesticides and Toxic Substances (H7501C)
PB92-185859
540-FS-92-195

EPA

Pesticide Fact Sheet

Name of Chemical: ethylene oxide (EtO)
Reason for Issuance: Response to Petition to Revoke Tolerances
Date Issued: May 31 , 1990
Fact Sheet Number: 234

1. DESCRIPTION OF CHEMICAL

Generic (Chemical) Name: 1,2-epoxyethane

Common Name: ethylene oxide (EtO)

Trade and Other Names: Oxyfume, Carboxide; Dihydrooxirene, dimethylene oxide, epoxyethane, EO, ETOX, oxacyclopropane, oxane, oxidoethane, oxirane (NAS, 1986)

EPA (Shaughnessy) Code: 042301

Chemical Abstracts Service (CAS) No.: 75-21-8

Year of Initial Registration: 1930s

Pesticide Type: Fumigant and Sterilant

Chemical Family: Epoxide

Producers: Union Carbide (Linde)
ARC Co. (Balchem)

2. USE PATTERNS AND FORMULATION

Application: Pesticidal fumigant applied to control insects, snails, bacteria, fungi, viruses, and other microorganisms. Mainly used in industrial chemical manufacture (99.0% of total use).

Method of Application: Applied within fumigation chambers of varying sizes. Rates vary according to commodity treated.

Annual Usage:	Total annual EtO use is approximately 6.5 billion pounds. Approx. 700,000 pounds used to fumigate spices and other natural seasonings (<0.01% of use).
Registered Uses:	Sterilant in hospital, medical, and pharmaceutical facilities; fumigant on ground and whole spices, walnut meats, and crops.
Formulations:	Gaseous mixtures with either carbon dioxide or fluorocarbon.

3. SCIENCE FINDINGS

Chemical Characteristics:

Color:	Colorless
Physical State:	Gas at room temperature; dissipates rapidly.
Odor:	Ether-like; sharp and unpleasant. Continuous exposure may result in loss of sense of smell.
Molecular Formula:	C_2H_4O
Melting Point:	-112.6°C
Boiling Point:	10.5°C
Density:	1.49 (high relative density)
Solubility:	Soluble in water, 195 ml vapor in 1 ml water at 20°C.
Vapor Pressure:	1095 mm Hg at 20°C; vapor detectable at 700 ppm and discernable as EtO in range of 900-1260 mg/m^3.
Flammability:	3%-100% at room temperature; highly flammable at temperatures above 10.4°C; highly reactive with compounds containing labile hydrogen atoms.
Miscibility:	Miscible in water, ether, acetone, benzene, methanol, and carbon tetrachloride.

Toxicity:

Inhalation Exposure: Inhalation exposures at or above 14,000 ppm are lethal to animals in minutes; exposures

between 700-7000 ppm are lethal within hours. At 700 ppm, animals experience depressed growth, nasal congestion, and testicular degeneration. Animals have, however, tolerated exposures below 700 ppm for weeks or months. Repeated exposures (2-8 weeks) to EtO vapor at or above 900 ppm produced reversible sensory and motor neurological impairment, peripheral neuropathy, and muscular atrophy in animals. Humans acutely poisoned by EtO have demonstrated headaches, nausea, vomiting, diarrhea, drowsiness, weakness, diminished coordination, respiratory irritation, salivation, convulsions, EKG abnormalities, and death. Acute studies on laboratory animals (rats) demonstrate LC_{50} values ranging between 835-5000 ppm, or 2630 mg/m^3, for a 4 hour exposure.

Oral Exposure: Currently, the data available on the human effects from EtO ingestion are insufficient to issue a complete human dietary assessment (see DATA GAPS section). EtO has four common reaction products which can remain in food after fumigation treatment: glycol (EG), 2-chloroethanol or ethylene chlorohydrin (ECH), ethylene bromohydrin (EBH) and chloroethanol esters of fatty acids (CEEs). In animal studies (rats) ingested EtO has demonstrated acute oral LD_{50} values of between 280-365 mg/kg of body weight.

Dermal Exposure: Dermal exposure can provoke skin burns (from 50% solutions) and sensitization: dermal contact with a 10 mg/L solution will cause mild skin irritation, while a 500 g/L solution will inflict skin injury.

Carcinogenicity:

EtO has been found to cause cancer in animals (rats, mice) when administered by inhalation, intragastric, and subcutaneous injection. Inhalation produced lung tumors, lymphomas, and uterine adenocarcinomas in mice. Inhalation studies on humans have related EtO exposure to increased incidence of leukemia, lymphomas, and other cancers. Based on epidemiology and animal studies, EtO is classified as a Class B_1 carcinogen (probable human), with the weight-of-evidence bearing closer to a Class B_2. A lifetime cancer risk to humans of continuous exposure to air containing an EtO concentration of 1 ug/m3 is 1×10^{-4} to 3.6×10^{-4}.

EtO was found to produce no tumors in human when dermally applied in an acetone solution. Tumor formation in animals from EtO ingestion has proven to be dose-responsive, suggesting probable oncogenic thresholds. This is important for humans because the aeration that follows food fumigation is expected to leave behind only low levels of EtO.

Available data are insufficient to judge actual dietary carcinogenicity from EtO. Further study is warranted because EtO and its reaction product ECH are both gene mutagens and because chemicals which are structurally related to EtO have been found oncogenic.

Mutagenicity:

EtO is a direct-acting (i.e., not requiring metabolic activation), general point (gene) mutagen capable of producing gene, chromosome, and germ cell mutations in mammals and non-mammals.

Alkyl radicals of EtO attach to various proteins and DNA throughout the body, inducing unscheduled DNA synthesis. Animal and human studies show that rates of exposure (dose and frequency) strongly influence mutagenicity.

Teratogenicity and Reproduction Effects:

EtO produces adverse reproductive and teratogenic effects (maternal toxicity, depression of fetal weight gain, fetal death, fetal malformation, reduces sperm numbers, and sperm mobility) in rats, mice, rabbits, and monkeys if the concentration of the chemical reaching the target organ is sufficiently high, or if exposure at lower levels is sufficiently long. There is a potential risk of developmental toxicity following a very short exposure period (minutes to hours, at approx. 100 ppm). For female animals sensitivity occurs during a substantial portion of the developmental period. For males, sensitive stages appear to be restricted to late spermatids and early spermatozoa. Impaired reproductive functions in male animals occurred at or above 90 mg/m^3 in intermittent long-term exposures. First generation carriers generally have reduced fertility, as well as increased incidences of developmental abnormalities in fetuses, fetal death, and phenotypic defects. While the nature of developmental effects is dependent upon dosage and length of exposure, data are unspecific as to the dose-responsiveness of brief exposures to EtO (minutes, hours) and consequent developmental toxicity.

Two human populations known to be at risk are 1) persons who routinely use the pesticide in the operation of sterilization equipment and/or spend most of their time in the immediate operating area of this equipment, and 2) persons who use EtO as a fumigant or routinely enter storage chambers shortly after such fumigation. Persons who ingest stored food products which have been fumigated with EtO do not appear to be exposed to levels to EtO that might affect the gonads. However, it is uncertain

to what extent the frequency and nature of translocations can be extrapolated from animal studies to humans.

Environmental Characteristics:

Environmental and ecological fate studies are not required given the closed application environment of EtO.

4. BENEFITS ANALYSIS

The American Spice Trade Association (ASTA) estimates that EtO was used to fumigate roughly 20% (182 million lbs.) of the total quantity of spices imported in 1987. Potential alternative treatment methods for microbial reduction in processed spices include gamma irradiation, microwave treatment, cleaning and drying the spices, and treatment with propylene oxide or methyl bromide. However, treatment with EtO is the preferred method in most instances because of its efficacy in controlling various bacteria, fungi, and molds which often contaminate imported spices. All of the domestic eastern black walnut crop is treated to control microbial contamination, but there is no indication that copra is treated.

Additional benefits of EtO on food commodities include: 1) minimal damage to texture, color, and flavor; 2) allowance for treatment after packaging, 3) highly diffusive character of EtO; and 4) rapid vaporization of residues from treated materials.

Until data from the DCI issued in October, 1989 are assembled, EtO appears to be the more effective and cost-efficient fumigant in many instances.

5. TOLERANCE ASSESSMENT

The 21 CFR 193.200 (redesignated as 40 CFR 193.200) established a 50 ppm food additive tolerance for EtO, applicable to ground spices and other processed natural seasoning materials. The 21 CFR 180.151 established the same tolerance for raw agricultural commodities, including whole spices, black walnut meats, and copra (coconut meat).

6. SUMMARY OF REGULATORY POSITIONS

In 1978, the Agency initiated a Special Review of the effects of occupational exposure to EtO. The Occupational Safety and Health Administration (OSHA) subsequently issued standards for occupational EtO exposure levels, and the OPP Special Review was discontinued for worker concerns. On 3/19/87, the Agency received a petition to revoke food additive tolerances for EtO on processed spices and processed seasonings. The Agency has issued a Data Call-In

B307
9

Notice to establish a data base sufficient to estimate the dietary risk from consumption of EtO-treated spices. The Agency does not believe that a decision on EtO tolerance revocation is appropriate until these data are received and evaluated.

7. DATA GAPS

The Agency issued a Data Call-In Notice in October, 1989, requiring the following data: (1) general product chemistry data; (2) residue chemistry data: a residue profile on EtO and any of its degradation products, including procedural descriptions, a processed food study, a persistence study, and a study to determine the effects of processing and cooking on residue levels of EtO and/or any degradation products; and (3) benefits and use data: an assessment of available benefits and use information for EtO and its possible alternatives. Once the Agency has reviewed these submissions it will be better able to determine gaps.

All data are due to be received by the Agency by September, 1991.

8. CONTACT PERSON AT EPA

Jill Gallagher, Review Manager
Special Review Branch
Special Review and Reregistration Division (H7508C)
Office of Pesticide Programs
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

Office location and phone number:
3rd Floor, Westfield Bldg.
2805 Jefferson Davis Hwy.
Arlington, VA 22202
(703) 308-8026

9. Disclaimer: The information in this Environmental Fact Sheet is a summary only and is not to be used to satisfy data sheet requirements for pesticide registration and reregistration. Contact the Review Manager listed above for further information.